CONSERVATION OF MOMENTUM IN 1 AND 2 DIMENSIONS
SPH4U LAB

Procedure:

- Event 1: One dimensional elastic collision between one puck (stationary) and one moving puck.
- Event 2: One dimensional inelastic collision between two pucks.
- Event 3: One dimensional inelastic collision between pucks of two different masses.
- Event 4: One dimensional elastic collision between two pucks of different masses.
- Event 5: Two dimensional elastic collision between pucks of the different masses.

Log onto the website: http://www.sciencejoywagon.com/explrsci/dswmedia/2dcollis.htm. NOTE: you may need to install shockwave on the computer to do so.

Complete the activities and questions below in Parts A-F as well as the concluding Thought Questions.

Part A: Elastic Collision, Identical Masses

1. Predict what will happen if a mass that is originally moving hits an equal mass that is originally stationary.
2. Now test your prediction by manipulating the conditions in the virtual collision experiment. Try to make this collision **perfectly linear** with the one puck headed straight at the other, motionless puck. Turn on the magnetic function as it approximates a nearly perfect elastic collision.
3. Summarize how the red puck's (R) velocity and momentum changed as a result of the collision. Summarize how the blue puck's (B) velocity and momentum changed as a result of the collision. (e.g. find m_1, v_1, p_1 as well as m_2, v_2, p_2). To find out velocity you will use the ruler function on the applet.
4. Did the total momentum before the collision equal the momentum after the collision? What is momentum? (Note how the change of each puck's momentum are equal.)
5. How did the initial kinetic energy (KE) compare to the final KE for each puck? What is the delta-KE for each puck? What was the delta-KE_{total}? Was energy conserved?

Part B: Inelastic Collision, Identical Masses

1. A totally inelastic collision occurs when the masses stick together after the collision. Predict what will happen if a puck that is originally moving hits and sticks to a puck that is originally stationary.
2. Now test your prediction by manipulating the conditions in the virtual collision experiment. Make sure that the inelastic collision toggle is on.
3. Summarize how the red puck's (R) velocity and momentum changed as a result of the collision, and indicate the puck's delta-KE. Summarize how the blue puck's (B) velocity and momentum changed as a result of the collision, and indicate the puck's delta-KE.

Part C: Inelastic Collision, Different Masses

1. Predict what will happen if a smaller mass that is originally moving hits and sticks to a larger mass that is originally stationary. Include in your predication how this may differ from the results obtained in the Part B collisions.
2. Test your prediction by manipulating the conditions in the virtual collision experiment. What happens in this collision? Do the results confirm or disprove your prediction? Explain your answers.

3. Now reverse the roles of the small and large pucks (i.e. the small puck should originally be stationary and the large puck should originally be moving), and predict what will happen in this collision. Include in your predication how this may differ from the results obtained in the Part B collisions, as well as how this may differ from the results obtained in Part C Steps 1-2.
4. Test your prediction by manipulating the conditions in the virtual collision experiment. What happens in this collision? Do the results confirm or disprove your prediction? Explain your answers.

Part D: Elastic Collision, Different Masses

1. Predict what will happen if a puck that is originally moving hits a heavier puck that is originally stationary.
2. Test your prediction by manipulating the conditions in the virtual collision experiment. What happens in this collision? Does this confirm or disprove your prediction? Explain your answers.
3. Now reverse the roles and predict what will happen in a collision in which the heavier mass is moving and the lighter mass is initially stationary.
4. Test your prediction by manipulating the conditions in the virtual collision experiment. What happens in this collision? Does this confirm or disprove your prediction? Explain your answers.

Part E: Two dimensional elastic collision with moving pucks of the different masses.

1. Predict what will happen if two pucks are propelled at each other having different masses and coming at each other on an angle that is not 0 or 180 degrees.
2. Chose pucks with two different masses (it will be easier on your calculations if $mass_1$ is an even ratio with $mass_2$.)
3. Make the angle non-zero. E.g. make the two pucks come at each other with a 'glancing' angle of incidence. (note: to analyze this you'll need to break your velocity (and thus momentum) vectors into the x & y components).
4. Does what you predict happen? Is momentum conserved?

Thought Questions to include in your discussion:

1. How was the collision in Part A different from Part B?
2. Describe what was conserved and what was not conserved in both elastic and inelastic collisions. Also explain what happened to the kinetic energy in inelastic collisions.
3. What are your conclusions about collisions that involve pucks of the same size as compared to pucks of differing sizes?
4. Will a head-on collision between two cars be more damaging to the occupants if the cars stick together upon impact or if they rebound? Explain your answer. (Note that in car accidents humans get injured by their impact with the interior of the car. That impact is equal to the car's (and human's) change of momentum.)